



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest and Alaska Fisheries Center
Resource Assessment and Conservation
Engineering Division
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CRUISE RESULTS

CRUISE 87-1 LETS GO
CRUISE 87-1 NORE-DICK
CRUISE 87-1 TAISEI MARU NO. 35
May-September 1987

The 1987 triennial bottom trawl survey of the central and western Gulf of Alaska was completed by scientists of the Northwest and Alaska Fisheries Center (NAFAC), Seattle, Washington, and the Far Seas Fisheries Research Laboratory, Shimizu, Japan, during the period May-September 1987. Eight hundred and twenty-eight bottom trawl stations ranging in depth from 20-750 meters (m) were completed between Cape St. Elias (144°30'W) and the Islands of Four Mountains (170°W) by the Japanese stern trawler Taisei Maru No. 35 and the U.S. stern trawlers Nore-Dick and Lets Go (Figure 1). A survey of the eastern Gulf of Alaska from Cape St. Elias to Dixon Entrance (132°W) was conducted by NAFAC personnel from the Auke Bay, Alaska, laboratory and is summarized in a separate report.

OBJECTIVES

The objectives of the 1987 survey were:

1. To estimate the abundance and distribution of commercially available groundfish species inhabiting the survey area.
2. To determine the biological population characteristics of the major groundfish species including size composition, age composition, size at maturity, length-weight relationships, morphometrics, feeding habits, etc.
3. To compare the relative fishing efficiencies of the U.S. and Japanese trawlers and trawl gear through an experiment involving side-by-side trawling at selected sites in the Kodiak Island area.



4. To collect horizontal and vertical opening measurements of the U.S. Noreastern trawls using acoustic net mensuration systems.
5. To collect a wide range of biological information for special studies.
6. To collect surface to bottom sea temperature profiles at selected trawling sites.

VESSELS AND GEAR

The two U.S. charter vessels, the 24 m Nore-Dick and 26 m Lets Go, are both house-forward style stern trawlers powered with 500 and 565 horsepower (hp) main engines, respectively. The 50 m Taisei Maru No. 35, chartered by the Japan Fisheries Agency, is a commercial stern trawler powered with a 3,400 hp main engine.

All bottom trawling by the U.S. vessels was conducted with a four seam, high-opening Noreastern trawl equipped with rubber bobbin roller gear. This standard survey trawl is constructed with polyethylene webbing, has headrope-footrope measurements of 26.5 and 35.6 m, respectively, and was joined to 1.8 X 2.7 m steel V-doors, weighing approximately 727 kilograms (kg) each, with 54.9 m triple dandyline.

The two seam Japanese trawl was also constructed of polyethylene webbing but had headrope-footrope dimensions of 55.6 and 65.0 m, respectively, and roller gear consisting of steel bobbins and automobile tires. This trawl was connected to 2.6 X 3.9 m curved steel doors, weighing approximately 3,200 kg each, with a single and double dandyline arrangement totaling 156 m.

SURVEY DESIGN AND METHODS

The central and western Gulf of Alaska survey area is dominated by the continental shelf, which generally lays shallower than 200 m and varies in width from approximately 10 nautical miles (nm) in the Fox Islands region to nearly 100 nm off the Kenai Peninsula and Kodiak Island. Representing nearly 90% of the 76,000 square nautical mile survey area, the continental shelf is bisected by numerous 100-300 m troughs or gullies which extend from the outer shelf shoreward towards the coast. Contiguous to the continental shelf at depths generally greater than 200 m but representing only 10% of the total survey area, the characteristically steep and rugged continental slope provides habitat for important species such as Pacific ocean perch, shortraker rockfish, and adult sablefish.

The survey area was divided into 43 subareas which were considered separately in terms of allocating survey effort and the subsequent data analysis. Shelf subareas were based primarily on the 100 and 200 m depth contours and geographical features such as banks, gullies, flats, etc. Slope subareas were defined by the 100, 200, 300, 500, 700, and 1,000 m depth contours and International North Pacific Fisheries Commission boundaries. For station selection, the shelf was overlaid by a square grid of points spaced 5 nm apart with the proportion of points actually sampled varying between subareas. Station densities within each subarea were set proportional to the variances of the average catch per unit effort (CPUE) for the most important species encountered during the 1984 survey. For example, the high variances obtained during the 1984 survey in eastern Shumagin Gully resulted in 82% of the grid points in this subarea being sampled in 1987. In the Semidi Bank subarea where CPUE variances were low in 1984, approximately 10% of the grid points were sampled. Each slope depth interval was subdivided into 25 nm² equal areas which were then systematically selected for sampling depending on the assigned station density.

During survey operations, the first trawlable bottom encountered near the selected station location was sampled. In choosing the exact location, only the bottom conditions indicated by the echo sounder were considered and not the presence or absence of fish sign. Each selected station was towed for one-half hour. In cases where there was not enough trawlable bottom for a full one-half hour tow, trawl data was accepted from tows as short as 10 minutes. A net sonde system was used by each vessel to monitor trawl behavior and time on bottom. Upon hauling the gear, catches were sorted to species, weighed, and measured. Additional biological data were also recorded and age structures and other special collections were obtained.

To estimate the relative differences in efficiency between the vessels and trawls used during the survey, an experiment was conducted east of Kodiak Island which involved side-by-side trawling at five locations selected on the basis of depth, trawlability, and the presence of important groundfish species. At each site, the general procedure was for each vessel to fish simultaneously in the same direction for 15 minutes. The vessels would then return to the starting position, change positions relative to each other, and complete another tow, repeating the process until each vessel had completed each parallel line twice.

RESULTS

A total of 828 trawl hauls were completed by the three vessels in the central and western Gulf of Alaska. Of these, 659 tows were successfully completed station tows while another 131 tows were completed during the fishing power experiment. A total of

34 tows were unsuccessful, mainly due to gear damage over rough bottom.

A net mensuration system consisting of a headrope unit and two wing units was used extensively on the U.S. vessels while on the Japanese vessel, a headrope transducer mounted sideways on the trawl wing was used to measure the width of the trawl. On all vessels, the trawl width generally increased with increasing depth. The wingspread of the U.S. Noreastern trawl varied between 14.1-15.5 m with the Lets Go exhibiting a larger spread by depth than the Nore-Dick. The wingspread of the Japanese trawl varied from 26.6 m at depths shallower than 100 m to 30.0 m at depths greater than 200 m.

The results of the fishing power experiment show that, in general, the U.S. Noreastern trawl was more efficient than the Japanese trawl (Table 1). Also, the catch rates obtained during the experiment by the U.S. vessels were very similar for most species except Pacific halibut, rock sole, and sablefish. In these cases, the Nore-Dick had significantly lower catch rates than both the Lets Go and the Taisei Maru No. 35, which may have been a result of the lower average towing speed of the Nore-Dick. The Japanese trawl was most efficient for only one species, shortraker rockfish.

The relative differences in fishing efficiencies between vessels were calculated for each species encountered during the experiment, converted to catch multipliers, and applied to the appropriate survey catches. For example, in the case of arrowtooth flounder, the Japanese survey catches were multiplied by 1.50, which is the ratio of the mean CPUE for arrowtooth flounder obtained by the U.S. vessels during the fishing power experiment and the CPUE obtained by the Japanese vessel. The smallest multiplier used to expand the Japanese survey catches was for sablefish (1.21) while the largest multiplier was for Dover sole (7.06).

As with the 1984 survey, arrowtooth flounder was the most abundant species taken during the 1987 survey (Table 2). Its 988,015 metric tons (t) of estimated biomass was considerably higher than other abundant species such as walleye pollock (843,544 t), Pacific halibut (527,944 t), Pacific cod (447,269 t), and sablefish (338,684 t). Other commercially important species contributing significantly to the total estimated biomass included rock sole (321,953 t), Pacific ocean perch (264,990 t), flathead sole (185,962 t), Dover sole (181,396 t), northern rockfish (171,154 t), dusky rockfish (144,281 t), and rex sole (102,190 t).

Species with distributions confined mainly to the inner continental shelf at depths generally less than 100 m included

yellowfin sole (53,280 t), Atka mackerel (33,407 t), butter sole (19,343 t), starry flounder (12,193 t), and Alaska plaice (4,891 t). Yellowfin sole catches were highest in bays along the lower Alaska Peninsula and adjacent to Kodiak Island, as were starry flounder and butter sole, while the largest concentrations of Alaska plaice were encountered along the upper Alaska Peninsula. Atka mackerel catches were confined to the western portion of the survey area between Unimak Island and Segum Pass. Species encountered primarily in depths between 101-200 m along the outer continental shelf, and to a lesser extent the gullies, included rex sole, Pacific ocean perch, northern rockfish, dusky rockfish, harlequin rockfish (54,435 t), and sharpchin rockfish (3,273 t), while walleye pollock were most abundant in the inner gullies and bays along the Alaska Peninsula and east of Kodiak Island. Pacific cod and Pacific halibut were both relatively evenly distributed over the inner and outer shelf regions, while arrowtooth flounder, sablefish, Dover sole, and shortspine thornyhead (79,069 t) had distributions encompassing both the continental shelf and slope regions.

The upper slope region between 200-500 m was dominated primarily by sablefish, arrowtooth flounder, Dover sole, rex sole, shortspine thornyhead, Pacific ocean perch, roughey rockfish, and shortraker rockfish, while the lower slope region deeper than 500 m contained large concentrations of giant grenadier (201,458 t), along with popeye grenadier (13,720 t), shortspine thornyhead, and sablefish.

Charts showing the distribution and abundance of selected groundfish species are shown in Figures 2-9. To compensate for differences in net widths between the U.S. and Japanese trawls and the different towing speeds of the three survey vessels, the station catches for each vessel were standardized to the operating width of the Noreastern trawl (approximately 15 m) and plotted in units of kg of catch per nautical mile.

PERSONNEL

Nore-Dick

Leg 1: May 30-June 16

Eric Brown, Chief Scientist
Gary Stauffer
Robert Loghry
Tom Rutecki

Fishery Biologist, NWAFC
Director RACE, NWAFC
Biological Technician, NWAFC
Fishery Biologist, ABL

Leg 2: June 18-July 9

Robert Wolotira, Chief Scientist	Fishery Biologist, NWAFC
Doyne Kessler	Fishery Biologist, NWAFC
Rae Baxter	Fishery Biologist, NWAFC
David Molenaar	Biological Technician, NWAFC

Leg 3: July 11-27

Lael Ronholt, Chief Scientist	Fishery Biologist, NWAFC
Robert Loghry	Biological Technician, NWAFC
Rae Baxter	Fishery Biologist, NWAFC
Douglas Knechtel	Biometrician, NWAFC

Lets GoLeg 1: May 30-June 16

Jim Long, Chief Scientist	Fishery Biologist, NWAFC
Brady Coleman	Fishery Biologist, NWAFC
David Clausen	Fishery Biologist, ABL
Christy Johnson	Biological Technician, NWAFC

Leg 2: June 18-28

Mark Wilkins, Chief Scientist	Fishery Biologist, NWAFC
Jim Stark	Fishery Biologist, NWAFC
Dave Baker	Biological Technician, NWAFC
Christy Johnson	Biological Technician, NWAFC

Leg 3: July 30-August 18

Tom Wilderbuer, Chief Scientist	Fishery Biologist, NWAFC
Ron Payne	Biological Technician, NWAFC
Leslie Sikora	Biological Technician, NWAFC
Vicki Poage	Biological Technician, NWAFC

Leg 4: August 19-September 5

Craig Rose, Chief Scientist	Fishery Biologist, NWAFC
Jim Stark	Fishery Biologist, NWAFC
Vicki Poage	Biological Technician, NWAFC
Yan Zheng	Fishery Biologist, ECSFRI

Taisei Maru No. 35Leg 1: May 15-June 12

Kei-ichi Mito, Chief Scientist
 Koji Shinohara
 Tom Wilderbuer

Fishery Biologist, FSFRL
 Participating Student, TUF
 Fishery Biologist, NWAFC

Leg 2: June 13-July 8

Kei-ichi Mito, Chief Scientist
 Koji Shinohara
 Ron Payne

Fishery Biologist, FSFRL
 Participating Student, TUF
 Biological Technician, NWAFC

Leg 3: July 15-August 10

Taku Yoshimura, Chief Scientist
 Koji Shinohara
 Brady Coleman

Fishery Biologist, FSFRL
 Participating Student, TUF
 Fishery Biologist, NWAFC

Leg 4: August 12-September 7

Taku Yoshimura, Chief Scientist
 Koji Shinohara
 Eric Brown

Fishery Biologist, FSFRL
 Participating Student, TUF
 Fishery Biologist, NWAFC

RACE = Resource Assessment and Conservation Engineering
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 NWAFC = Northwest and Alaska Fisheries Center, Seattle, WA
 FSFRL = Far Seas Fisheries Research Laboratory, Shimizu, Japan
 TUF = Tokyo University of Fisheries, Tokyo, Japan
 ABL = Northwest and Alaska Fisheries Center, Auke Bay
 Laboratory, Auke Bay, AK
 ECSFRI = East China Seas Fisheries Research Institute, Shanghai,
 Peoples Republic of China

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Table 1.--Relative differences in fishing power observed during the 1987 fishing power comparison (FPC) experiment and the resulting fishing power multipliers used to adjust the survey catches.

Species	<u>Relative differences between vessels</u>			<u>Catch multiplier</u>		
	U.S. 1	U.S. 2	Japan	U.S. 1	U.S. 2	Japan
Skates	1.00	.89	.52	--	--	1.82
Arrowtooth flounder	1.00	.96	.65	--	--	1.50
Pacific halibut	.41	1.00	.67	2.43	--	1.47
Flathead sole	1.00	.92	.46	--	--	2.08
Dover sole	1.00	.88	.13	--	--	7.06
Rex sole	1.00	.95	.38	--	--	2.58
Rock sole	.46	1.00	.15	--	--	4.96
Walleye pollock	.87	1.00	.43	--	--	2.20
Pacific cod	1.00	.77	.59	--	--	1.52
Sablefish	.53	1.00	.82	1.87	--	1.21
Shortspine thornyhead	.83	1.00	.36	--	--	2.54
Pacific ocean perch	1.00	.94	.38	--	--	2.55
Rougheye rockfish	.83	1.00	.62	--	--	1.48
Northern rockfish	1.00	.36	.72	--	--	1.38
Shortraker rockfish	.55	.87	1.00	1.82	1.14	--

Table 2. -- Estimated biomass (t) and 95 percent confidence intervals for the principal species encountered during the 1987 U.S.- Japan cooperative bottom trawl survey of the central and western Gulf of Alaska.

Species	Estimated biomass	95% confidence intervals		% of mean
		Lower	Upper	
Arrowtooth flounder	988,015	822,492	1,153,536	17
Walleye pollock	843,544	606,704	1,080,379	28
Pacific halibut	527,944	410,584	645,305	22
Pacific cod	447,269	349,121	545,413	22
Sablefish	338,684	128,841	515,068	60
Rock sole	321,953	271,296	406,078	20
Pacific ocean perch	264,990	138,097	391,885	48
Giant grenadier	201,458	85,496	317,419	58
Flathead sole	185,962	152,786	219,139	18
Dover sole	181,396	85,456	277,332	53
Northern rockfish	171,154	24,488	446,390	161
Dusky rockfish	144,281	16,376	272,183	89
Rex sole	102,190	78,314	126,063	23
Shortspine thornyhead	79,069	52,551	105,589	34
Harlequin rockfish	54,435	8,089	100,780	85
Yellowfin sole	53,280	30,329	76,230	43
Rougheye rockfish	34,017	23,115	44,919	32
Shortraker rockfish	33,903	1,118	66,687	97
Atka mackerel	33,407	0	96,711	189
Popeye grenadier	13,720	10,007	17,432	27
Starry flounder	12,193	4,026	20,361	67
Butter sole	19,343	4,301	34,383	78
Alaska plaice	4,891	2,421	7,361	51
Sharpchin rockfish	3,273	0	9,807	200
English sole	3,051	0	6,648	118

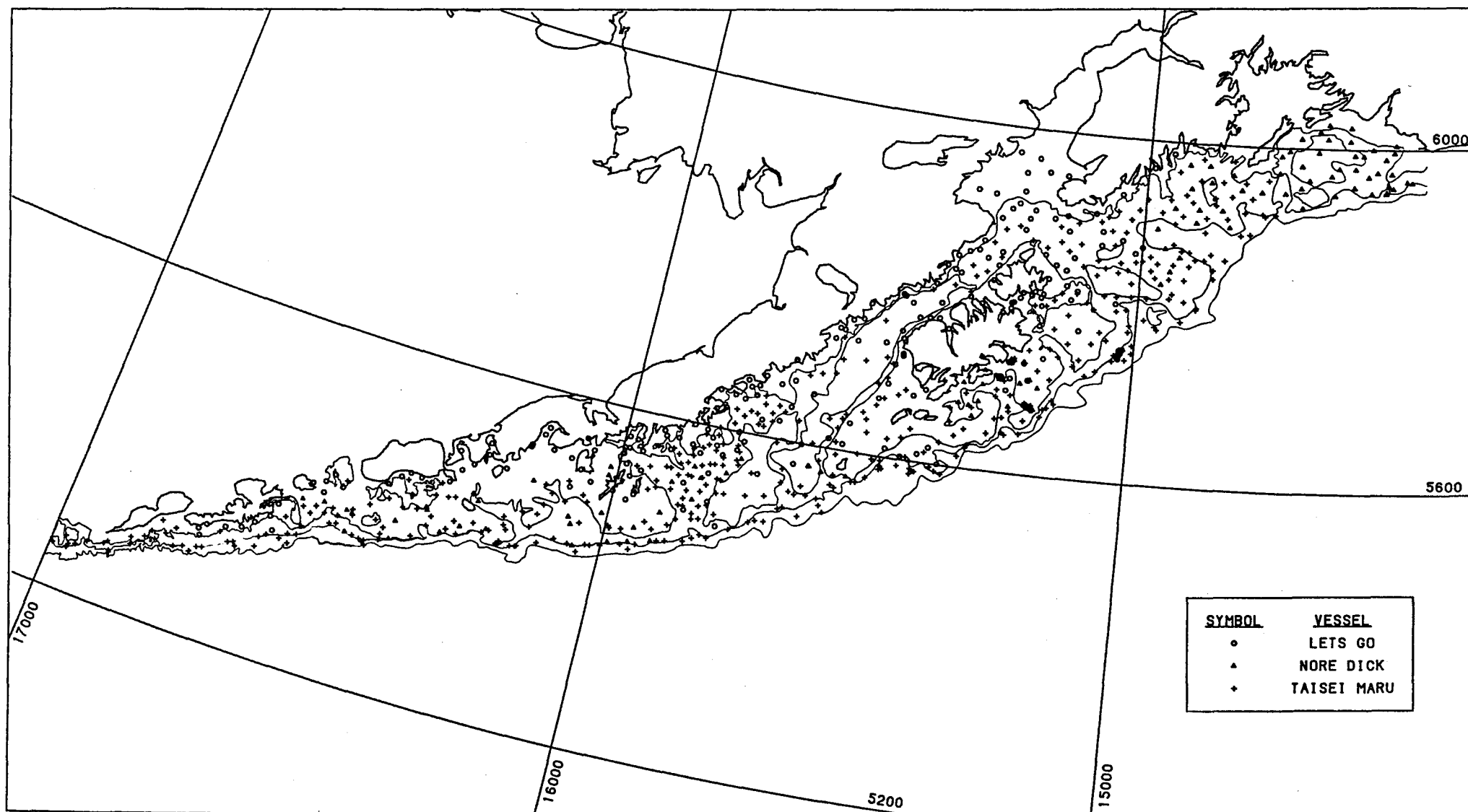


Figure 1.--Trawl hauls completed during the 1987 U.S.-Japan cooperative bottom trawl survey of the central and western Gulf of Alaska.

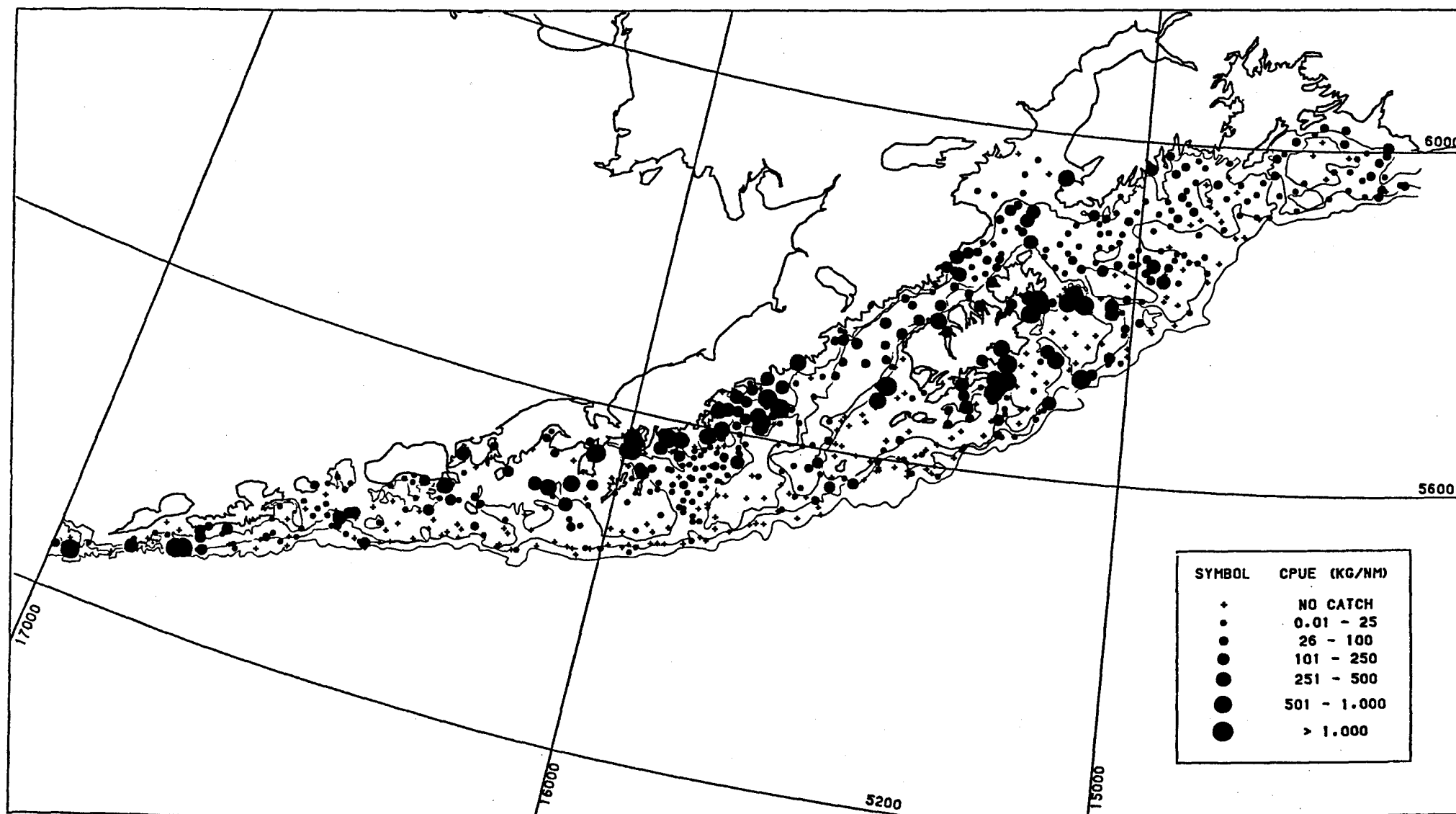


Figure 2.--Catch per unit effort (kg/nm) of walleye pollock for survey stations completed during the 1987 U.S.-Japan cooperative bottom trawl survey of the central and western Gulf of Alaska.

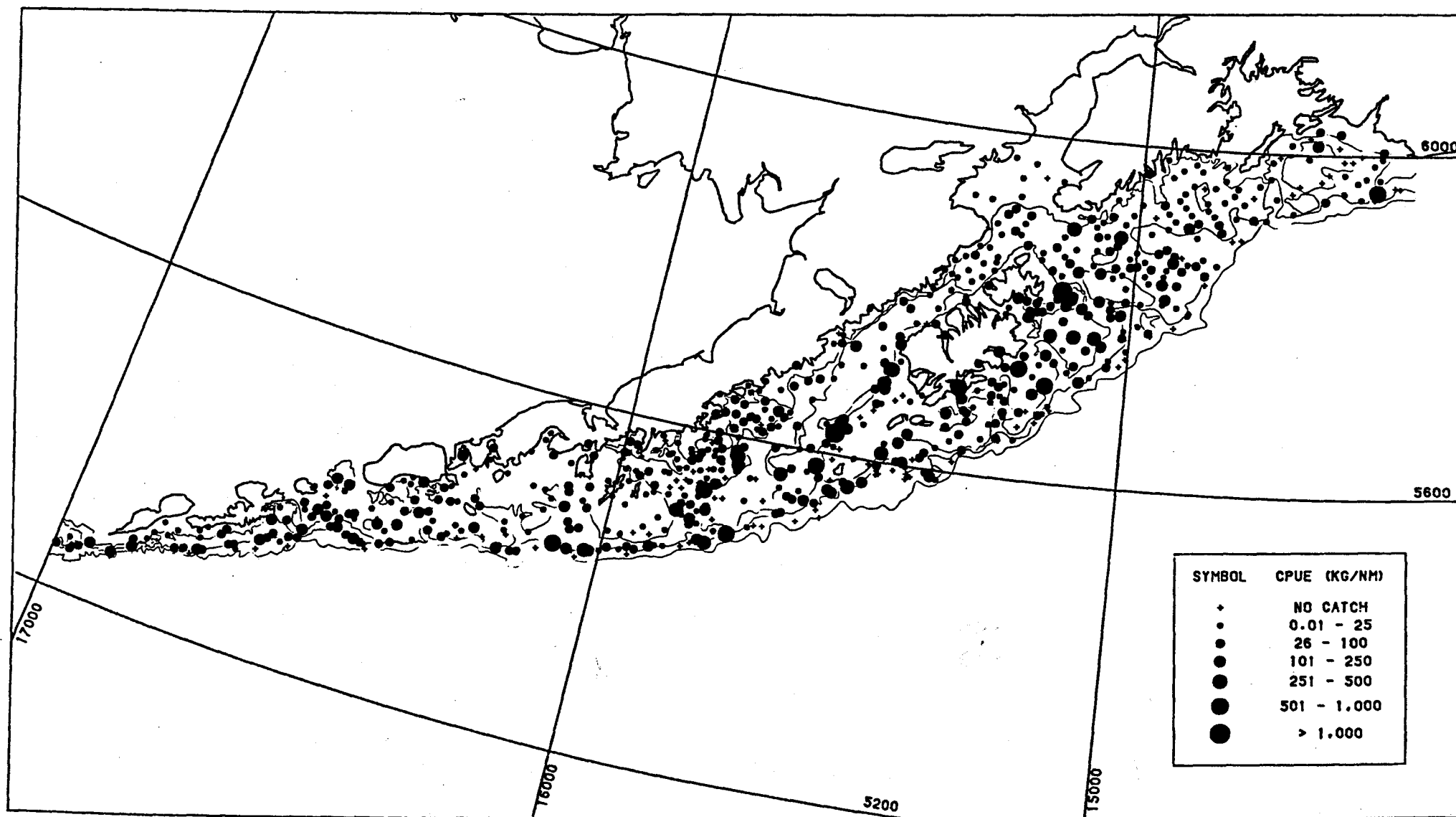


Figure 3.--Catch per unit effort (kg/nm) of Pacific cod for survey stations completed during the 1987 U.S.-Japan cooperative bottom trawl survey of the central and western Gulf of Alaska.

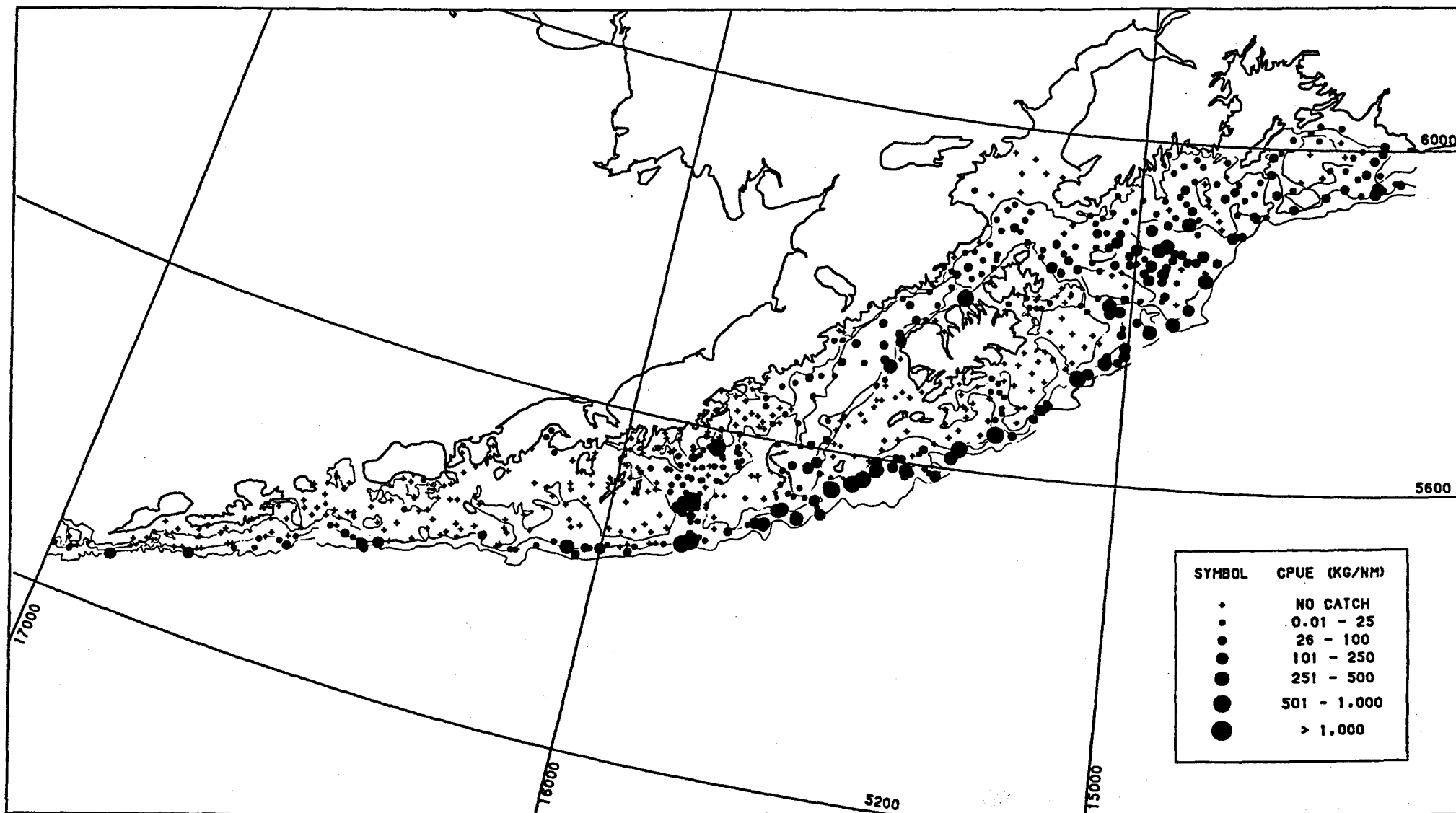


Figure 4.--Catch per unit effort (kg/nm) of sablefish for survey stations completed during the 1987 U.S.-Japan cooperative bottom trawl survey of the central and western Gulf of Alaska.

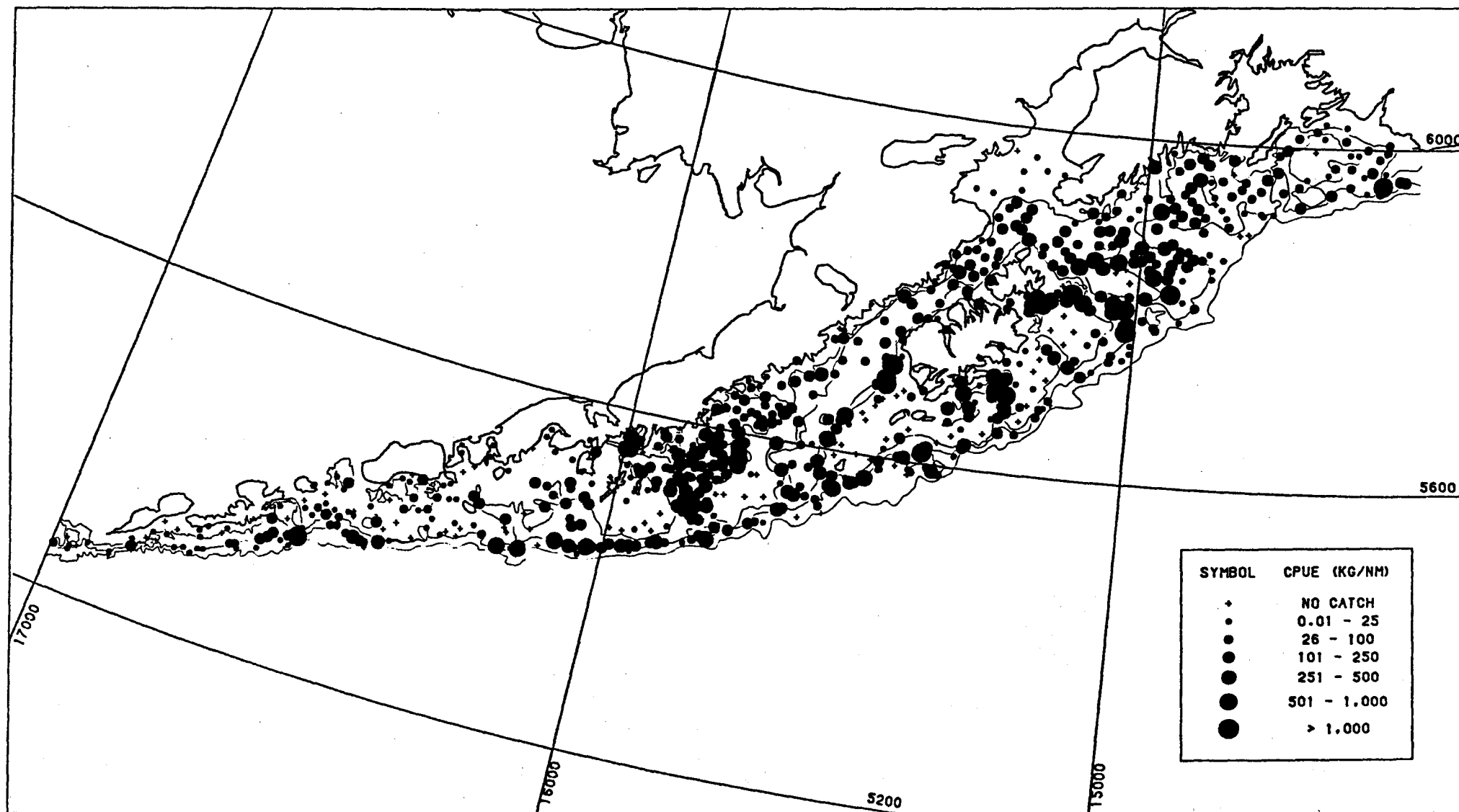


Figure 5.--Catch per unit effort (kg/nm) of arrowtooth flounder for survey stations completed during the 1987 U.S.-Japan cooperative bottom trawl survey of the central and western Gulf of Alaska.

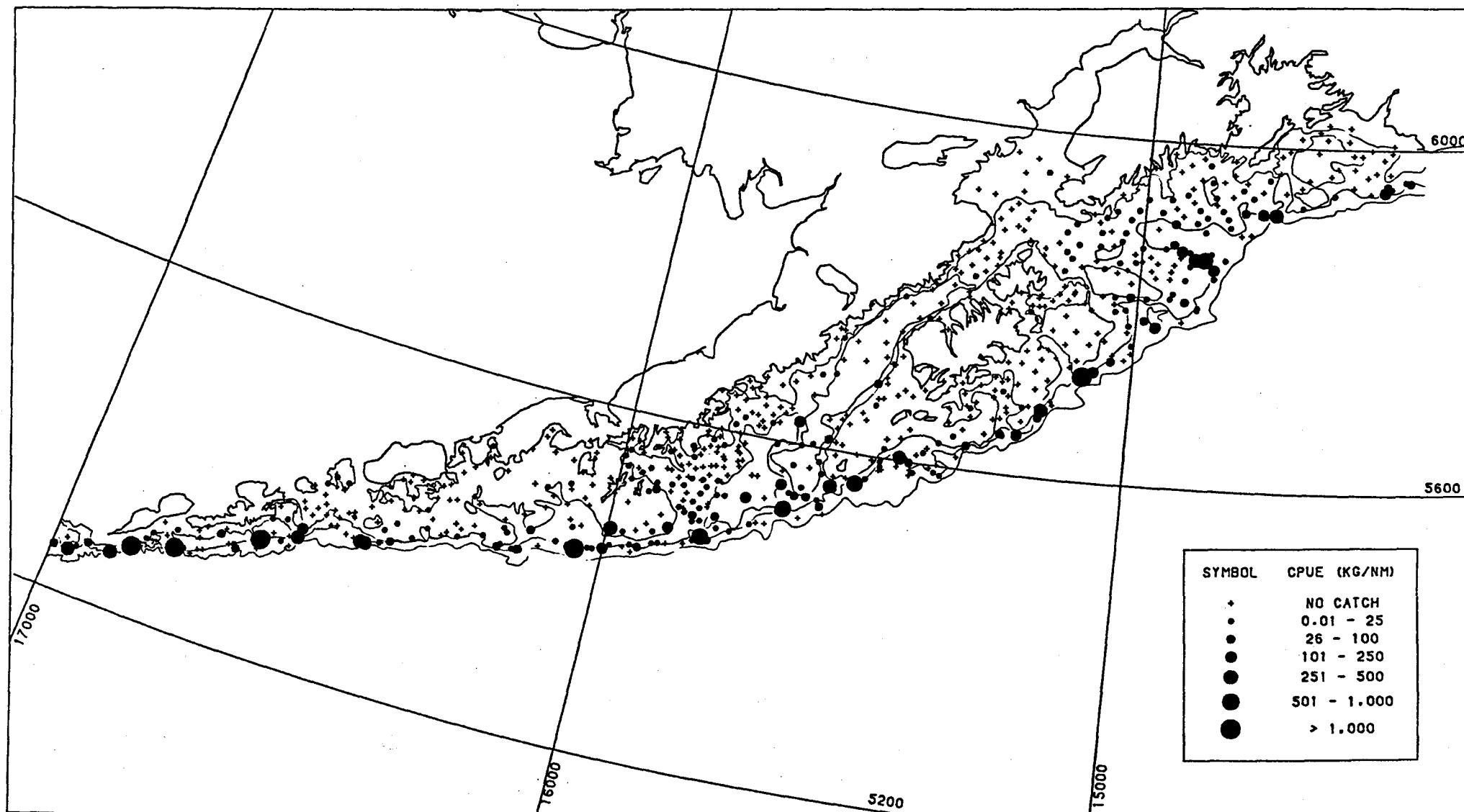


Figure 7.--Catch per unit effort (kg/nm) of Pacific ocean perch for survey stations completed during the 1987 U.S.-Japan cooperative bottom trawl survey of the central and western Gulf of Alaska.

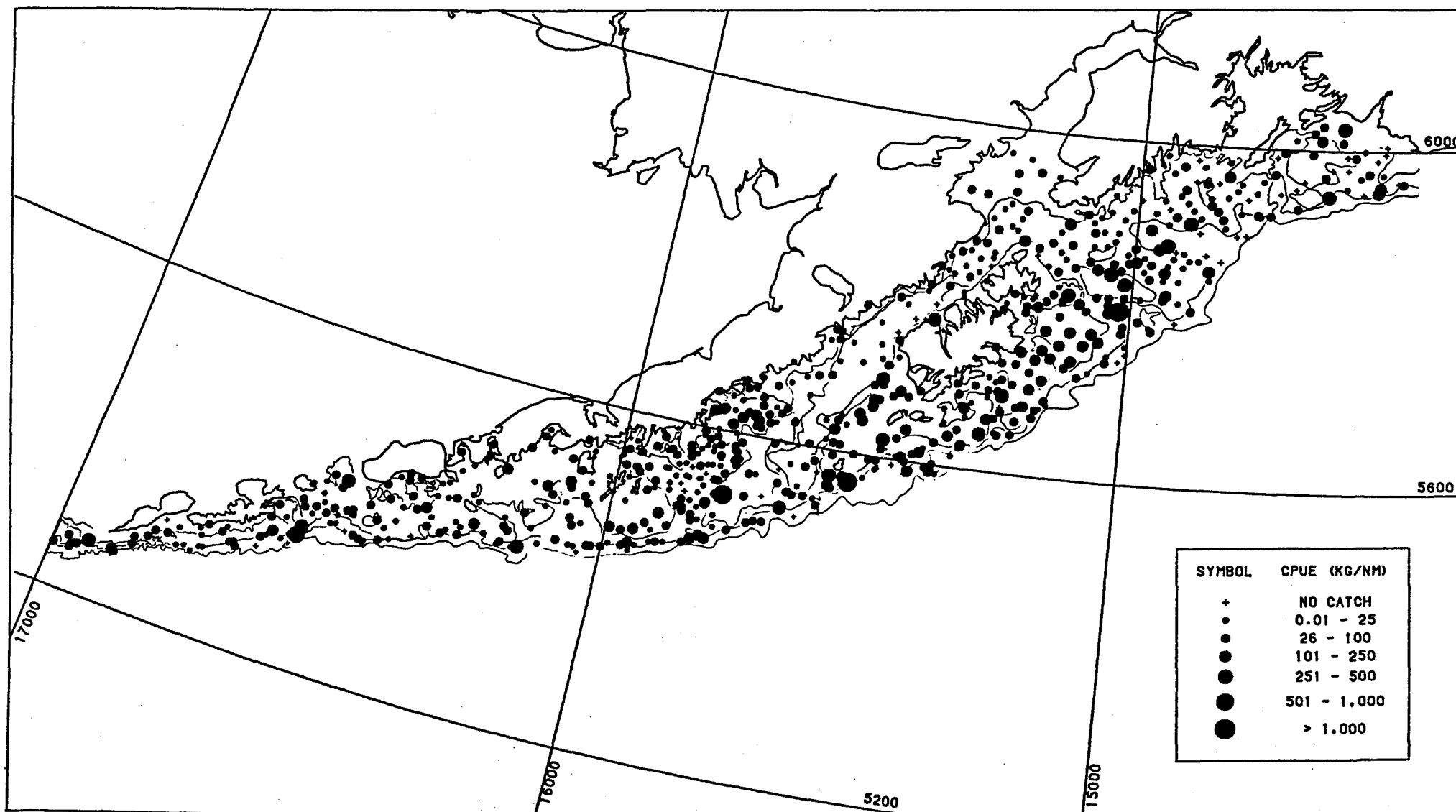


Figure 6.--Catch per unit effort (kg/nm) of Pacific halibut for survey stations completed during the 1987 U.S.-Japan cooperative bottom trawl survey of the central and western Gulf of Alaska.

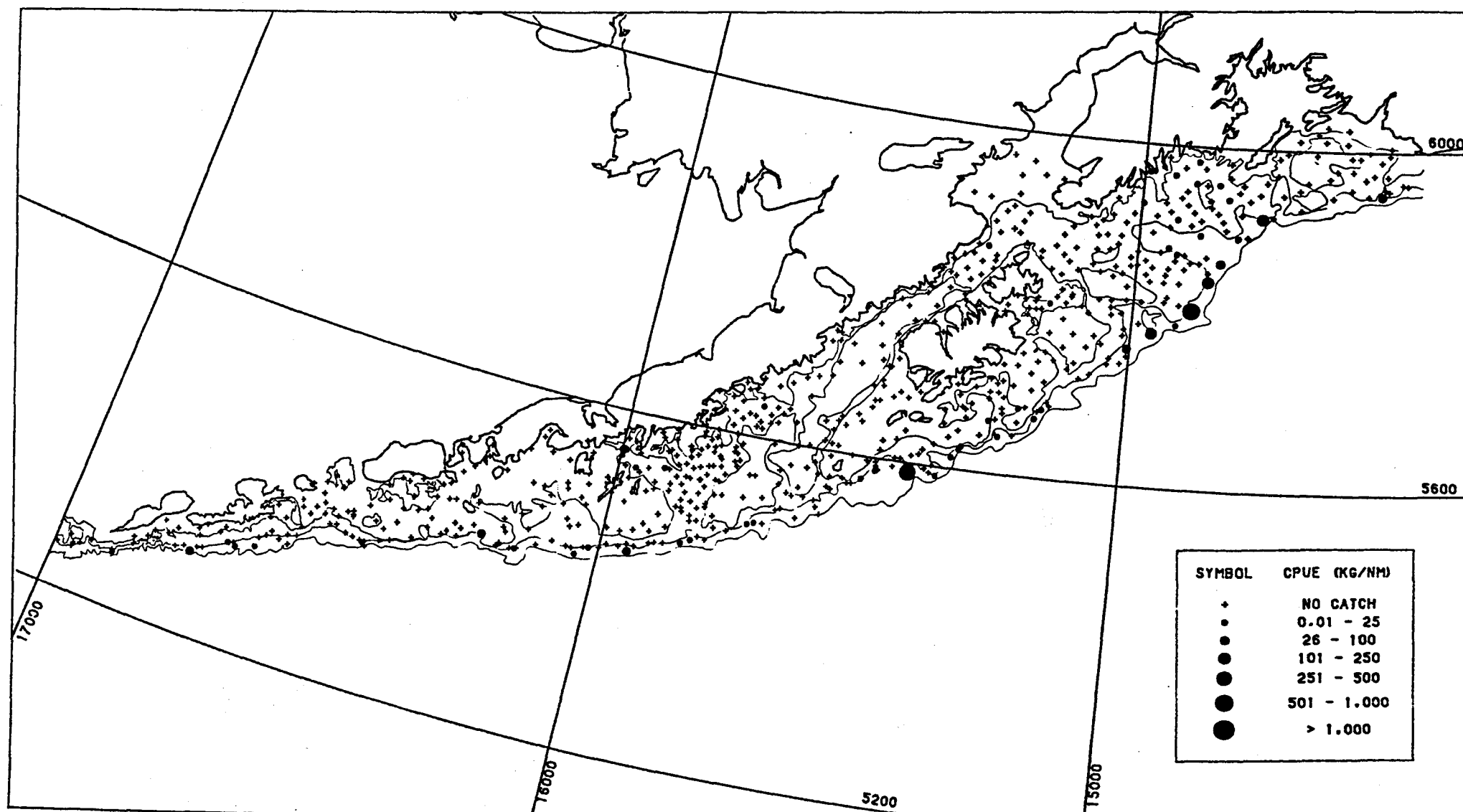


Figure 8.--Catch per unit effort (kg/nm) of shorttraker rockfish for survey stations completed during the 1987 U.S.-Japan cooperative bottom trawl survey of the central and western Gulf of Alaska.

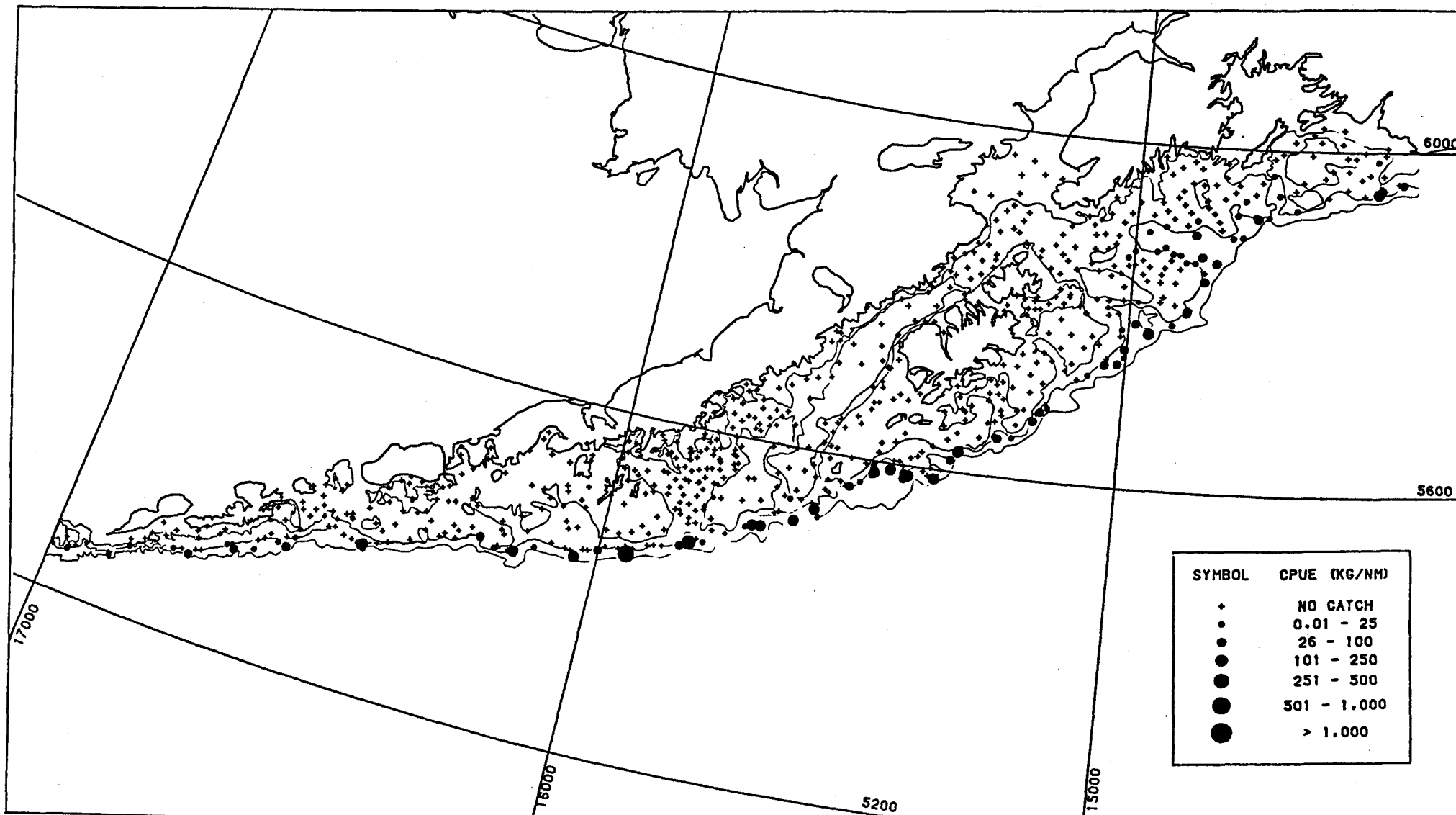


Figure 9.--Catch per unit effort (kg/nm) of shortspine thornyheads for survey stations completed during the 1987 U.S.-Japan cooperative bottom trawl survey of the central and western Gulf of Alaska.